



**PATENT APPLICATION**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of

Docket No: Q54114

KAWABE, YASUMASA, et al.

Appln. No.: 09/295,329

Group Art Unit: 1752

Confirmation No.: 7050

Examiner: Y. CLARKE

Filed: April 21, 1999

For: POSITIVE PHOTSENSITIVE RESIN COMPOSITION

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**DECLARATION UNDER 37 C.F.R. § 1.132**

**BOX AF**

Commissioner for Patents  
Washington, D.C. 20231

Sir:

I, Yasumasa Kawabe, declare and state that:

I graduated from Shinshu University, Faculty of Engineering, Course of Synthetic Chemistry in March, 1980.

In April of 1980, I was employed by Kurabe Co., Ltd, and since that time have been engaged in the study of physical properties of polymers.

From September of 1983 to March of 1986, I studied synthesis of electroconductive polymers at the polymer Laboratory of Aichi Institute of Technology, Course of Applied Chemistry as a research student.

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Since April of 1986, I have been employed by Fuji Photo Film Co., Ltd., and engaged in the study of photopolymers and photo-resists at the Yoshida-minami Laboratories of said Company.

#### **THE 5% DIFFERENCE IN RESIDUAL FILM RATE**

In the microphotoresist, the resist residual film rate is generally required to be 99% or more. Recently, in the production of semiconductor devices, there is very strong demand for higher residual film rates.

If the residual film rate of the resist is low, the following problems occur:

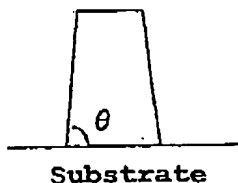
- (1) The desired etching resistance is not obtained; and
- (2) The coverage property of the resist on substrates having a deviation in the level is worsened. This causes breaking of wire.

That is, the residual film rate is ideally preferably 100%. Accordingly, a difference of the residual film rate of "5%" would be regarded as an extremely large difference in the resist industry and to one skilled in the resist art. Thus, a difference in the residual film rate of "5%" would be considered to be an unexpected result to one skilled in the art of the present invention.

#### **THE EVALUATION OF THE PROFILE "A" AND "B"**

The shape of the resist is shown in Figure 1 below, where the cross section of a 0.25  $\mu\text{m}$  pattern is schematically shown.

Figure 1



When an angle ( $\theta$ ) between the substrate and the side-wall of the resist pattern is small, the profile (i.e., the shape of resist pattern) is a tapered shape (i.e., a T-shape). When the angle ( $\theta$ ) between the substrate and the sidewall is large, the profile is a rectangular shape.

Accordingly, in the present invention, the tapered profile (i.e., the T-shape) (designated as "B" in the present specification) means that the angle ( $\theta$ ) between the substrate and the sidewall is about from 80 to 85°.

A rectangular profile (i.e., the rectangular shape) (designated as "A" in the present specification) means that the angle ( $\theta$ ) between the substrate and the sidewall is about from 85 to 90°.

Thus, in view of measurement of the line width for the resist, the angle ( $\theta$ ) between the substrate and the sidewall is most preferably from 88 to 89°.

The angle between the substrate and the sidewall for contrasting Profile "A" and "B" shown in Table A' of the previous declaration is shown below.

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	<u>Profile</u>	<u>Angle between Substrate and Sidewall</u>
Example a	A	89
Example b	A	88
Comparative Example a'	B	85
Comparative Example b'	B	86

As shown by the samples of the present invention, achievement of both improvement of performance in the development defect and the realization of a rectangular profile, which have been extremely difficult to obtain, are unexpectedly realized by the combination of the present invention.

Also, the angle between the substrate and the sidewall of the examples according to the present invention is in the range of from 88 to 89°, which is ideal.

#### **THE UNEXPECTED EFFECTS SHOWN IN PROFILE A AND PROFILE B**

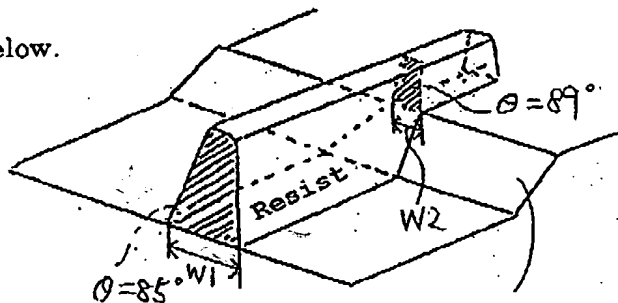
The change of the residual film rate and the shape of the resist by the addition of the claimed surfactant is an unexpected effect.

Previously, the residual film rate and the profile have been considered to be influenced by the polymer, the acid generator and the nitrogen-containing basic compound, which are the main constitutional components of the resist.

It is unknown in the art that the residual film rate and the profile would be extremely changed by addition of the surfactant. Therefore, such an effect is considered to be an unexpected effect.

#### THE EFFECT OF A DIFFERENCE BETWEEN PROFILE A AND PROFILE B

It is a disadvantage to have a variation in the Profile and to have a difference in the level. For example, when the angle (between the substrate and the sidewall) differs between  $89^\circ$  (which is within the range of the Profile A) and  $85^\circ$  (which is within the range of the Profile B) (i.e., a  $4^\circ$  difference), there is a large difference in the line width between an upper part and a lower part when there is a difference in level. See Figure 2 below.



**Difference in level**

Even if the angle between the substrate and the sidewall ( $\theta$ ) is slight, the difference in the line width ( $W1$ ) and ( $W2$ ) becomes large when there is a difference in level. As shown in Figure 2  $W1 > W2$ . That is, the difference between Profile A and Profile B becomes extremely large and the difference of the line width of the pattern becomes large. This is detrimental and is not preferable.

*level?*

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Also, when the angle between the substrate and the sidewall of the profile is small (as shown in Profile B, i.e., 85%), damage easily occurs upon the dry etching.

Accordingly, having a difference between Profile A (i.e., 89%) and Profile B (i.e., 85%) is an extremely large difference and the difference between Profile A and Profile B would be considered to be an significant and unexpected effect to one skilled in the art.

In Example a and Comparative a' of Table A and A', submitted on December 21, 2002, the type of the surfactant used is different. Similarly, Example b and Comparative Example b' differ in the type of the surfactant used.

As is apparent from the results of Table A and A', the residual film rate and in the profile are extremely changed by the difference in the surfactant used. That is, a specific and unexpected effect in the residual film and the profile is obtained by the use of the combination as claims including the claimed type of surfactant.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both,

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under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: Aug. 30, 2002

Yasumasa Kawabe  
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